In re Application of Hosono et al.
Application No. Unassigned

REMARKS

The foregoing amendments are made to correct minor translational errors and to meet United States requirements as to form. No new matter is added.

Respectfully submitted,

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PATENT
Attorney Docket No. 401225

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

HOSONO et al.

Application No.:	Unassigned	Art Unit:	Unassigned
Filed:	June 4, 2001	Examiner:	Unassigned
For:	CARBON THIN BODY, PROCESS FOR PRODUCING THE CARBON THIN BODY, AND ELECTRIC FIELD EMISSION TYPE ELECTRON SOURCE USING THE CARBON THIN BODY		

SPECIFICATION, CLAIMS AND ABSTRACT AS PRELIMINARILY AMENDED

Amendments to the paragraph beginning at page 2, line 2:

The use of the carbon ~~thin~~ body made of the carbon nanotubes as a planar electron source has been expanded. Because of its unique structure, however, it has been considered that the carbon ~~nanotubes~~ nanotube has ~~unknown~~ no known use.

Amendments to the paragraph beginning at page 2, line 6:

However, (a) carbon nanotubes are not formed unless the temperature of the substrate for them is raised to a given temperature or higher; (b) an expensive catalyst is required for forming nanotubes; (c) carbon nanotubes have small ~~adhesiveness~~ adhesion to the substrate owing to their structure; and (d) in the case that carbon nanotubes are used as a planar electron source, it is necessary to use a conductive substrate, or form the carbon nanotubes after a conductive film is formed on a nonconductive substrate since the

respective nanotubes are electrically independent of each other. As shown in Fig. 27, in order to supply an electric current or voltage to perpendicularly-oriented carbon nanotubes 113 ~~in~~ when the ~~case that a~~ substrate 102 is ~~insulated~~ insulating, it is necessary to deposit a conductive film 105 on the substrate 102 and then form the perpendicularly-oriented carbon nanotubes thereon. The electric current or voltage is supplied from an electric current source or a voltage source to the conductive film 105.

Amendments to the paragraph beginning at page 2, line 20:

In the case that carbon nanotubes are used as a planar electron source, an inexpensive glass substrate cannot be used because of the substrate temperature referred to in ~~the~~ item (a). This hinders the use of carbon nanotubes, which are originally expensive. The drawbacks referred to in ~~the~~ items (b) and (d), together with the drawback referred to in ~~the~~ item (a), cause an increase in costs for making carbon nanotubes ~~to~~ for a planar electron source.

Amendments to the paragraph beginning at page 13, line 28:

Fig. 1 is a view of the front surface of a carbon thin body composed of an approximately netlike wall, which is observed with a scanning electron microscope (SEM) [20000X ~~magnifications~~ magnification];

Amendments to the paragraph beginning at page 13, line 31:

Fig. 2 is a perspective view of a cross section along the direction in which the carbon thin body shown in Fig. 1 grows, and the front surface side of the body, which are observed with a scanning electron microscope (SEM) [5000X ~~magnifications~~ magnification];

Amendments to the existing claims:

1. (Amended) A carbon ~~thin~~ body that has a ~~given~~ thickness and is ~~in the form of~~ a thin layer having a front surface and a back surface, ~~wherein~~ including at least ~~in its~~ at the front surface ~~portion~~ a continuous curved wall ~~is continuous~~, as ~~is~~ viewed in plan, ~~to form an approximately~~ having a netlike structure.

2. (Amended) The carbon ~~thin~~ body according to claim 1, wherein said curved wall ~~is arranged to~~ approximately ~~surround given~~ surrounds openings in a curved form, as ~~is~~ viewed in plan, ~~and substantially constitute~~ as peripheral portions of ~~said~~ the openings.

3. (Amended) The carbon ~~thin~~ body according to claim 1, including an object having a surface on which said carbon body is positioned ~~on a surface of an object~~, the back surface of said carbon ~~thin~~ body contacting the surface of the object, and said curved wall standing up ~~in a standing-wall form~~ from ~~said~~ the surface of the object.

4. (Amended) The carbon ~~thin~~ body according to claim 1, wherein a base that occupies the back surface ~~side~~ within said carbon ~~thin~~ body is ~~formed in~~ a continuous film ~~form to be~~ embedded in ~~said~~ the openings.

5. (Amended) The carbon ~~thin~~ body according to claim 1, wherein said curved wall has a hexagonal ~~system~~ crystal structure ~~and the~~ with a bottom plane ~~of said hexagonal system crystal is arranged in~~ parallel to ~~the~~ a direction that crosses the front surface of said carbon ~~thin~~ body.

6. (Amended) The carbon ~~thin~~ body according to claim 1, wherein said curved wall has an average thickness of no more than 100 nm ~~or less~~.

7. (Amended) The carbon ~~thin~~ body according to claim 1, wherein ~~its~~ an electrical current can flow between any two points ~~that are arbitrarily selected conduct electrically~~ on the carbon body.

8. (Amended) The carbon ~~thin~~ body according to claim 3, wherein ~~said surface of~~ the object is a ~~surface of a~~ glass substrate.

9. (Amended) A process for producing a carbon ~~thin~~ body, including ~~the step of using~~ <u>generating a</u> plasma ~~which is generated from~~ <u>in a</u> gas containing a carbon compound and ~~which~~ <u>applying</u> a magnetic field and ~~an~~ electromagnetic ~~wave are applied~~ <u>waves</u> to~~, so as~~ <u>the plasma</u> to form the carbon ~~thin~~ body on a surface of an object by chemical vapor ~~growth~~ <u>deposition</u>, wherein ~~said~~ <u>the</u> magnetic field and the electromagnetic ~~wave~~ <u>waves</u> satisfy a resonance condition for electrons in ~~said~~ <u>the</u> plasma.

10. (Amended) The process for producing the carbon ~~thin~~ body according to claim 9, wherein the ~~direction of said~~ magnetic field and the ~~direction along which said~~ electromagnetic ~~wave advances are~~ <u>waves advance</u> in <u>a direction</u> parallel to ~~each other and cross said~~ <u>the magnetic field, crossing the</u> surface of the object.

11. (Amended) The process for producing the carbon ~~thin~~ body according to claim 9, wherein ~~said~~ <u>the</u> electromagnetic ~~wave is a microwave~~ <u>waves are microwaves</u>.

12. (Amended) The process for producing the carbon ~~thin~~ body according to claim 9, wherein ~~ingredient~~ gases for generating ~~said~~ <u>the</u> plasma include a carbon-containing compound and hydrogen ~~gas~~, and the ~~ratio of the~~ hydrogen ~~gas in the ingredient gases ranges~~ <u>has a concentration range</u> from 25% to 75%.

13. (Amended) The process for producing the carbon ~~thin~~ body according to claim 9, wherein ~~said surface of~~ the object is a ~~surface of a~~ glass substrate.

14. (Amended) The process for producing the carbon ~~thin~~ body according to claim 9, wherein ~~said surface of~~ the object is heated at <u>no more than</u> 700°C ~~or lower~~.

15. (Amended) An electric field emission type electron source, ~~wherein~~ including a carbon ~~thin~~ body ~~in which at least in its~~ having a front surface ~~portion~~ with a continuous curved wall ~~is continuous to have an approximately~~ having a netlike structure ~~is used~~ as an electron emitting member for emitting electrons ~~forward~~.

16. (Amended) The electric field emission type electron source according to claim 15, wherein the ~~diameter of~~ wall surrounds openings ~~surrounded by said wall in said approximately netlike structure is~~ and the openings have a diameter larger than ~~the~~ height of the wall.

17. (Amended) The electric field emission type electron source according to claim 15, ~~which includes~~ including a cathode ~~pulling-out~~ electrode for supplying electrons to said carbon ~~thin~~ body, and ~~a~~ an extraction electrode for generating an electric field for ~~emitting~~ inducing emission of the electrons from ~~the~~ said carbon ~~thin~~ body, wherein said carbon ~~thin~~ body is positioned ~~ahead~~ in front of ~~said~~ the cathode ~~pulling-out~~ electrode, contacting the ~~upper of said~~ cathode ~~pulling-out~~ electrode, and ~~said~~ the extraction electrode is positioned ~~ahead~~ in front of the carbon ~~thin~~ body ~~in the manner~~ so that ~~said~~ the extraction electrode does not overlap ~~with~~ the carbon ~~thin~~ body, as ~~is~~ viewed in plan.

18. (Amended) The electric field emission type electron source according to claim 15, ~~which includes~~ including a cathode ~~pulling-out~~ electrode for supplying electrons to said carbon ~~thin~~ body, and a backside extraction electrode, positioned ~~in the~~ at a rear side of said carbon ~~thin~~ body, for generating, from the rear side, an electric field for ~~emitting~~ inducing emission of the electrons from ~~the~~ said carbon ~~thin~~ body, wherein the cathode ~~pulling-out~~ electrode is positioned ~~ahead~~ in front of ~~said~~ the backside extraction electrode, and said carbon ~~thin~~ body is positioned ~~ahead~~ in front of the cathode ~~pulling-out~~ electrode, contacting the ~~upper of the~~ cathode ~~pulling-out~~ electrode.

19. (Amended) The electric field emission type electron source according to claim 18, wherein ~~said~~ the cathode ~~pulling-out~~ electrode is ~~arranged~~ located only ~~in the~~ at a periphery of said carbon ~~thin~~ body.

20. (Amended) The electric field emission type electron source according to claim 18, wherein ~~said~~ the cathode ~~pulling-out~~ electrode is positioned outside ~~said~~ the backside extraction electrode and not ~~to overlap~~ overlapping with ~~said~~ the backside extraction electrode as ~~is~~ viewed in plan.

Amendments to the abstract:

ABSTRACT OF THE DISCLOSURE

~~Obtained are a~~A carbon ~~thin~~ body ~~having~~ has a structure ~~making it possible to produce~~ for producing a planar electron source in a simple manner; a process for producing the carbon ~~thin~~ body; and an electric field emission ~~type~~ electron source using the carbon ~~thin~~ body. ~~A~~The carbon ~~thin~~ body ~~that has a given thickness and~~ is ~~in the form of~~ a thin layer having a front surface and a back surface, ~~wherein~~ and at least ~~in~~ the front surface ~~portion~~ is a continuous curved wall ~~is continuous~~, as ~~is~~ viewed in plan, ~~to form an approximately~~ having a netlike structure.

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CLAIMS PENDING AFTER PRELIMINARY AMENDMENT

1. A carbon body that has a thickness and is a thin layer having a front surface and a back surface, including at least at the front surface a continuous curved wall, as viewed in plan, having a netlike structure.

2. The carbon body according to claim 1, wherein said curved wall approximately surrounds openings in a curved form, as viewed in plan, as peripheral portions of the openings.

3. The carbon body according to claim 1, including an object having a surface on which said carbon body is positioned, the back surface of said carbon body contacting the surface of the object, and said curved wall standing up from the surface of the object.

4. The carbon body according to claim 1, wherein a base that occupies the back surface within said carbon body is a continuous film embedded in the openings.

5. The carbon body according to claim 1, wherein said curved wall has a hexagonal crystal structure with a bottom plane parallel to a direction that crosses the front surface of said carbon body.

6. The carbon body according to claim 1, wherein said curved wall has an average thickness of no more than 100 nm.

7. The carbon body according to claim 1, wherein an electrical current can flow between any two points on the carbon body.

8. The carbon body according to claim 3, wherein the object is a glass substrate.

9. A process for producing a carbon body, including generating a plasma in a gas containing a carbon compound and applying a magnetic field and electromagnetic waves to the plasma to form the carbon body on a surface of an object by chemical vapor deposition, wherein the magnetic field and the electromagnetic waves satisfy a resonance condition for electrons in the plasma.

10. The process for producing the carbon body according to claim 9, wherein the magnetic field and the electromagnetic waves advance in a direction parallel to the magnetic field, crossing the surface of the object.

11. The process for producing the carbon body according to claim 9, wherein the electromagnetic waves are microwaves.

12. The process for producing the carbon body according to claim 9, wherein gases for generating the plasma include a carbon-containing compound and hydrogen, and the hydrogen has a concentration range from 25% to 75%.

13. The process for producing the carbon body according to claim 9, wherein the object is a glass substrate.

14. The process for producing the carbon body according to claim 9, wherein the object is heated at no more than 700°C.

15. An electric field emission type electron source, including a carbon body having a front surface with a continuous curved wall having a netlike structure as an electron emitting member for emitting electrons.

16. The electric field emission type electron source according to claim 15, wherein the wall surrounds openings and the openings have a diameter larger than height of the wall.

17. The electric field emission type electron source according to claim 15, including a cathode electrode for supplying electrons to said carbon body, and an extraction electrode for generating an electric field for inducing emission of the electrons from said carbon body, wherein said carbon body is positioned in front of the cathode electrode, contacting the cathode electrode, and the extraction electrode is positioned in front of the carbon body so that the extraction electrode does not overlap the carbon body, as viewed in plan.

18. The electric field emission type electron source according to claim 15, including a cathode electrode for supplying electrons to said carbon body, and a backside extraction electrode, positioned at a rear side of said carbon body, for generating, from the rear side, an electric field for inducing emission of the electrons from said carbon body, wherein the cathode electrode is positioned in front of the backside extraction electrode, and said carbon body is positioned in front of the cathode electrode, contacting the cathode electrode.

19. The electric field emission type electron source according to claim 18, wherein the cathode electrode is located only at a periphery of said carbon body.

20. The electric field emission type electron source according to claim 18, wherein the cathode electrode is positioned outside the backside extraction electrode and not overlapping with the backside extraction electrode as viewed in plan.